1972

CORNELL AERONAUTICAL LABORATORY, INC.
OF CORNELL UNIVERSITY
P. O. BOX 235 • BUFFALO, NEW YORK • 14221
TELEPHONE 716-632-7500

June 23, 1972

Mr. Al Fritz
Schwinn Bicycle Company
1856 North Kostner Avenue
Chicago, Illinois 60639

Dear Al:

Enclosed you will find additional plots of the performance efficiency study and tables of the measured physical characteristics of the Paramount and the Stingray.

These new plots show the horsepower requirements versus speed for the bicycle configurations and riding conditions used in the plots I sent June 2, 1972. As you will see many of the curves are bunched together, making it difficult to appreciate the differences among the various configurations. This is another reason why the speed difference plots are more enlightening than the horsepower plots. Nevertheless, the horsepower plots have their use in relating various performance levels to human capabilities.

We have finished measuring the physical characteristics of the Paramount and the Stingray. The respective data are shown on the enclosed tables.

The rider guidance-steer control mode has been programmed in the bicycle simulation. Checkout tests of this mode are currently being performed. Plans are being made to begin the full scale experimental tests with the instrumented bicycle. It is expected that this experimental work will be completed by the end of July.

I have also enclosed a graph which shows estimated and actual expenditures and progress on the program by individual task. This plot is a result of recent laboratory emphasis on program planning and is very useful as a summary of month to month progress.

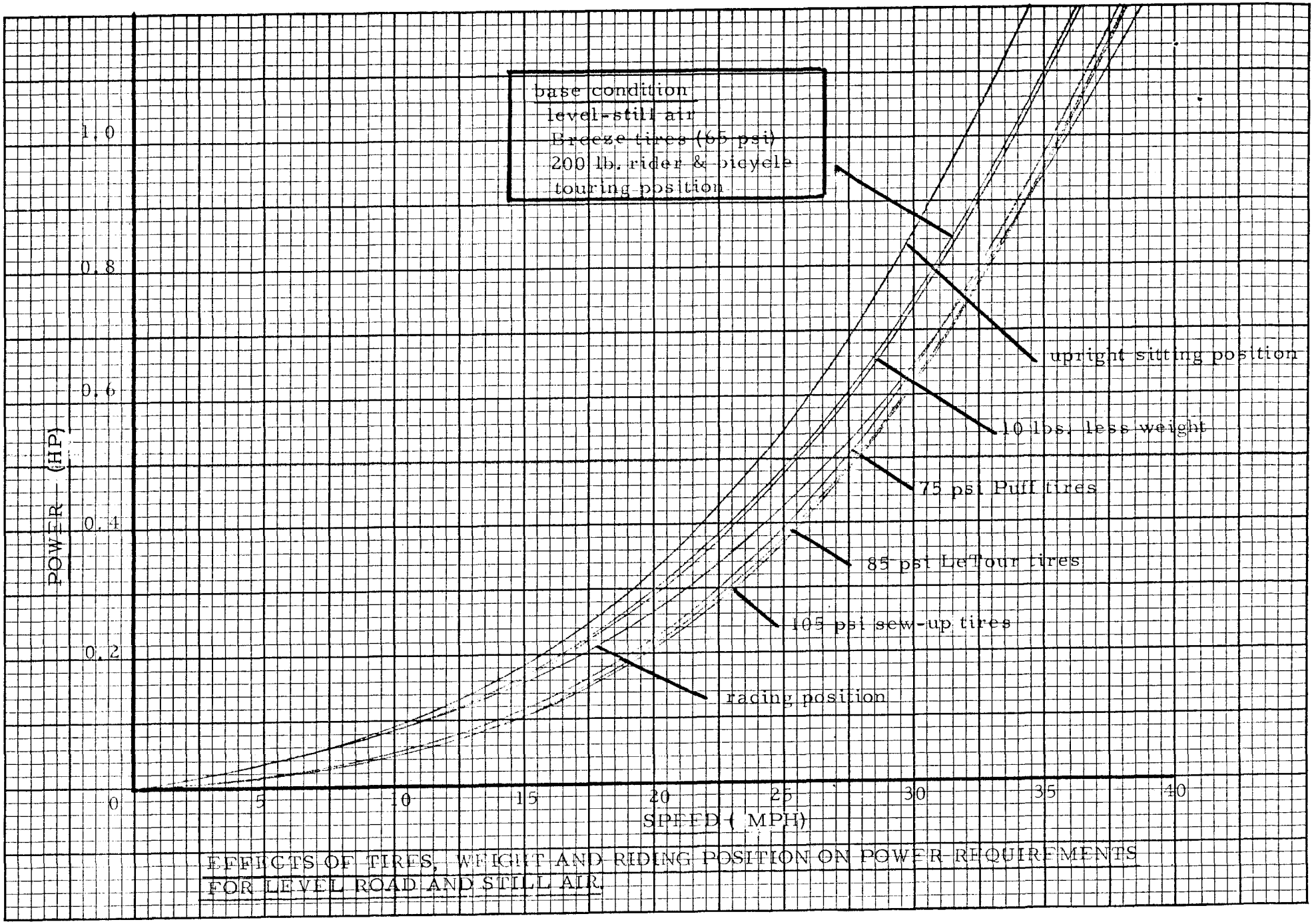
I have written some notes on my experience with the Campagnolo Gran Turisimo rear derailleur on both the Sports Tourer and the Paramount. However, before sending these I will wait until I have tried the Campagnolo bottom bar levers and cable guides on the Sports Tourer and the new Shimano Crane GS derailleur on the Paramount.

Sincerely,

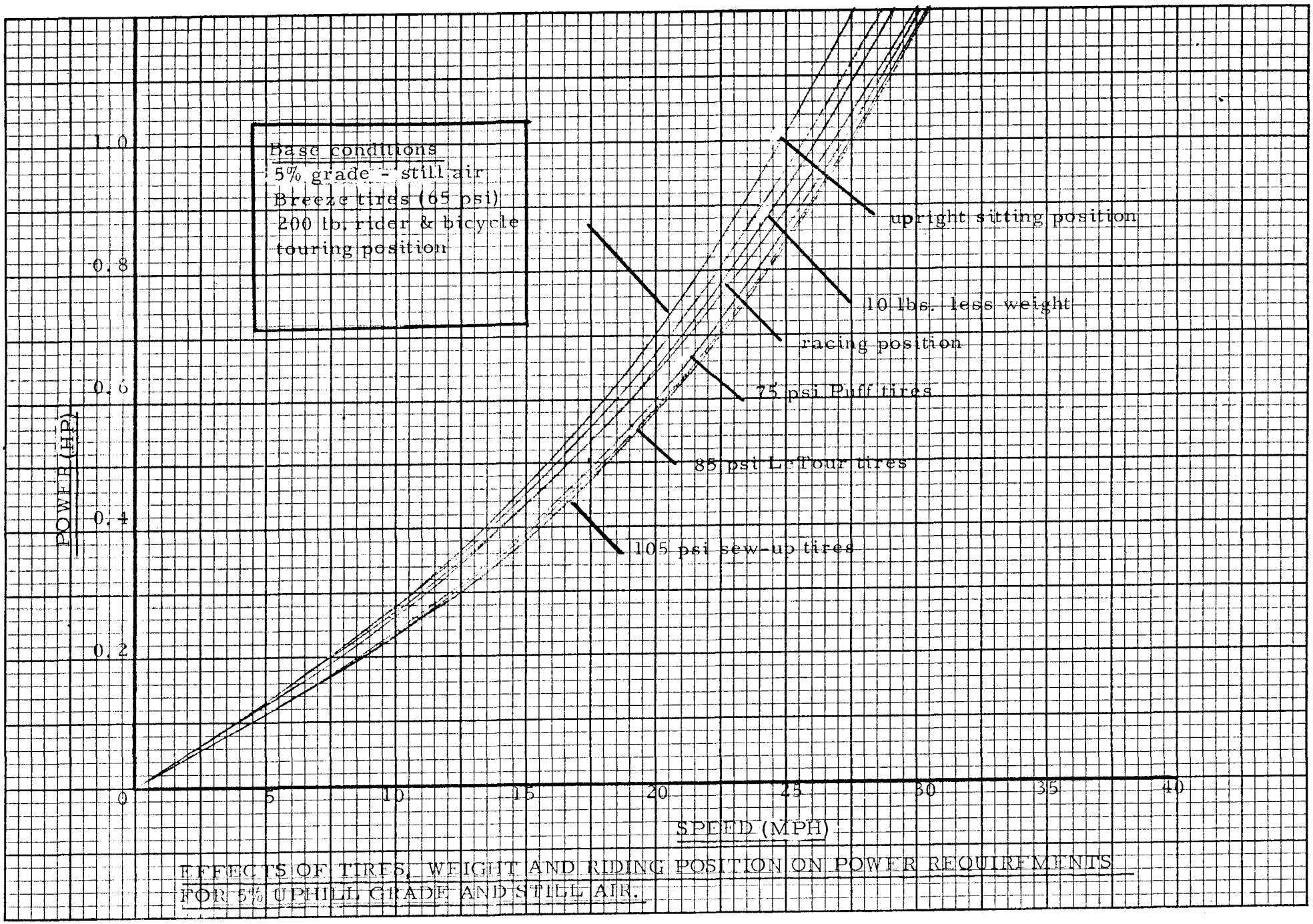
Doug

R. Douglas Roland
Vehicle Research Department

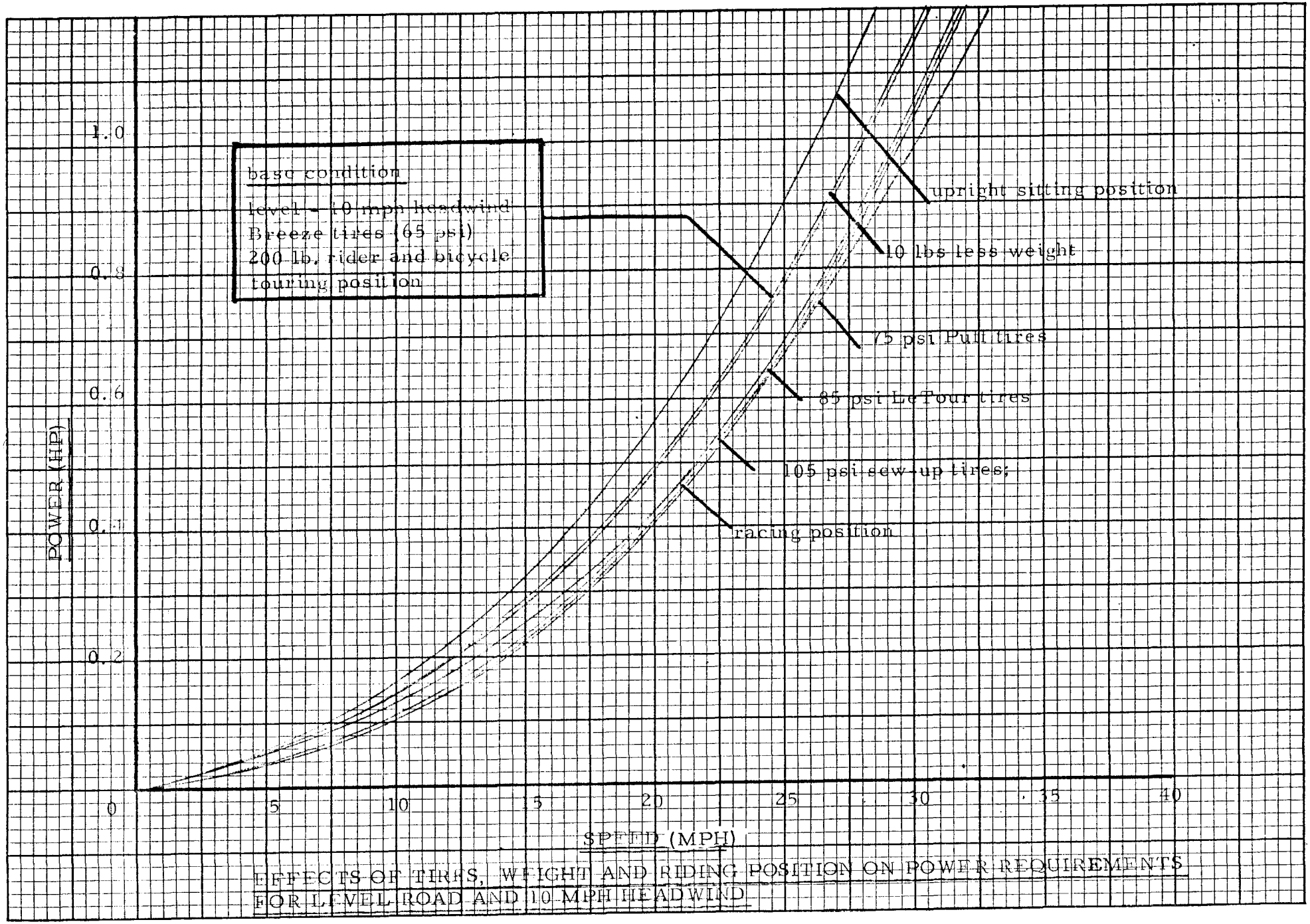
RDR:em
Encls.



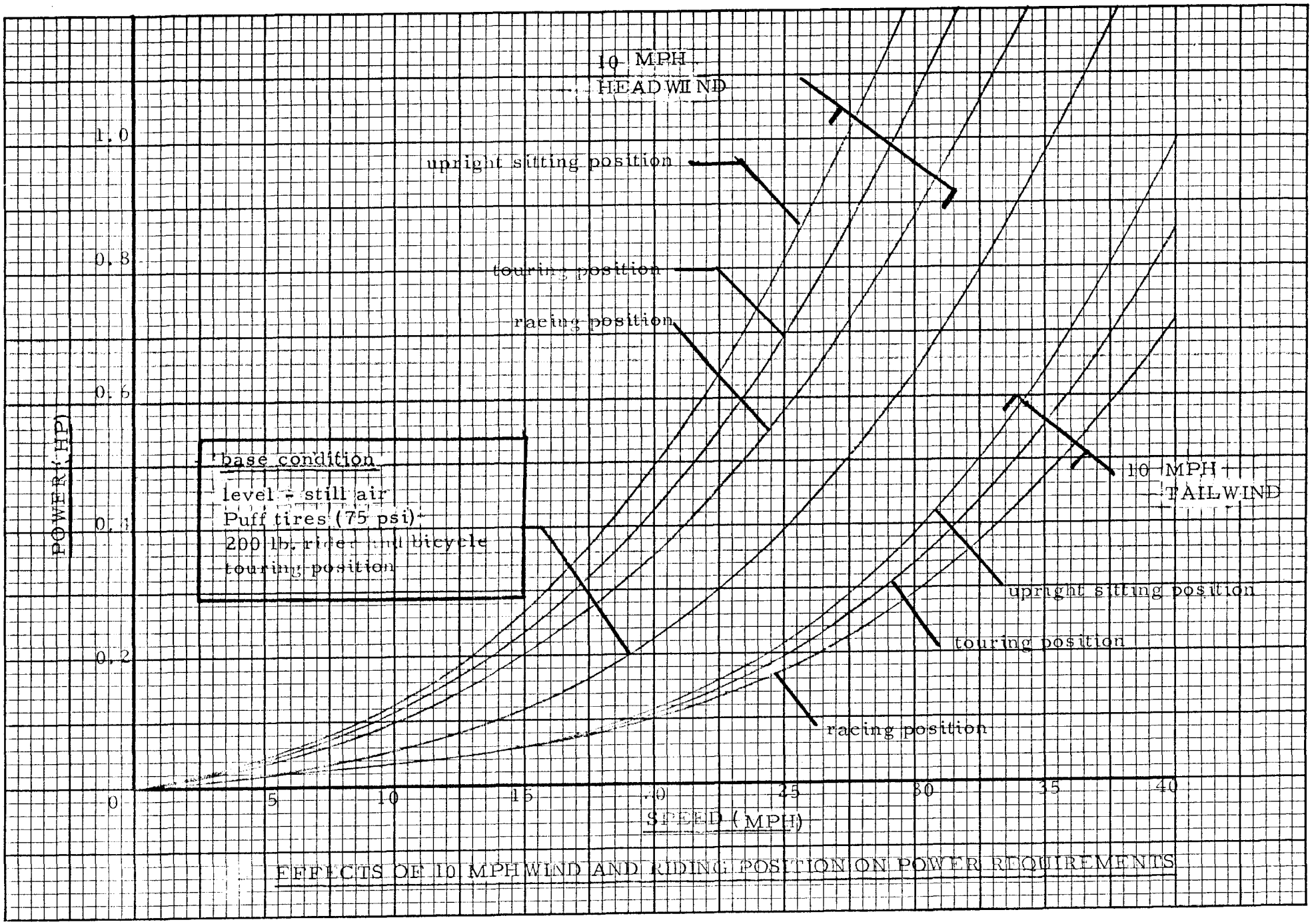
EFFECTS OF TIRES, WEIGHT AND RIDING POSITION ON POWER REQUIREMENTS FOR LEVEL ROAD AND STILL AIR.



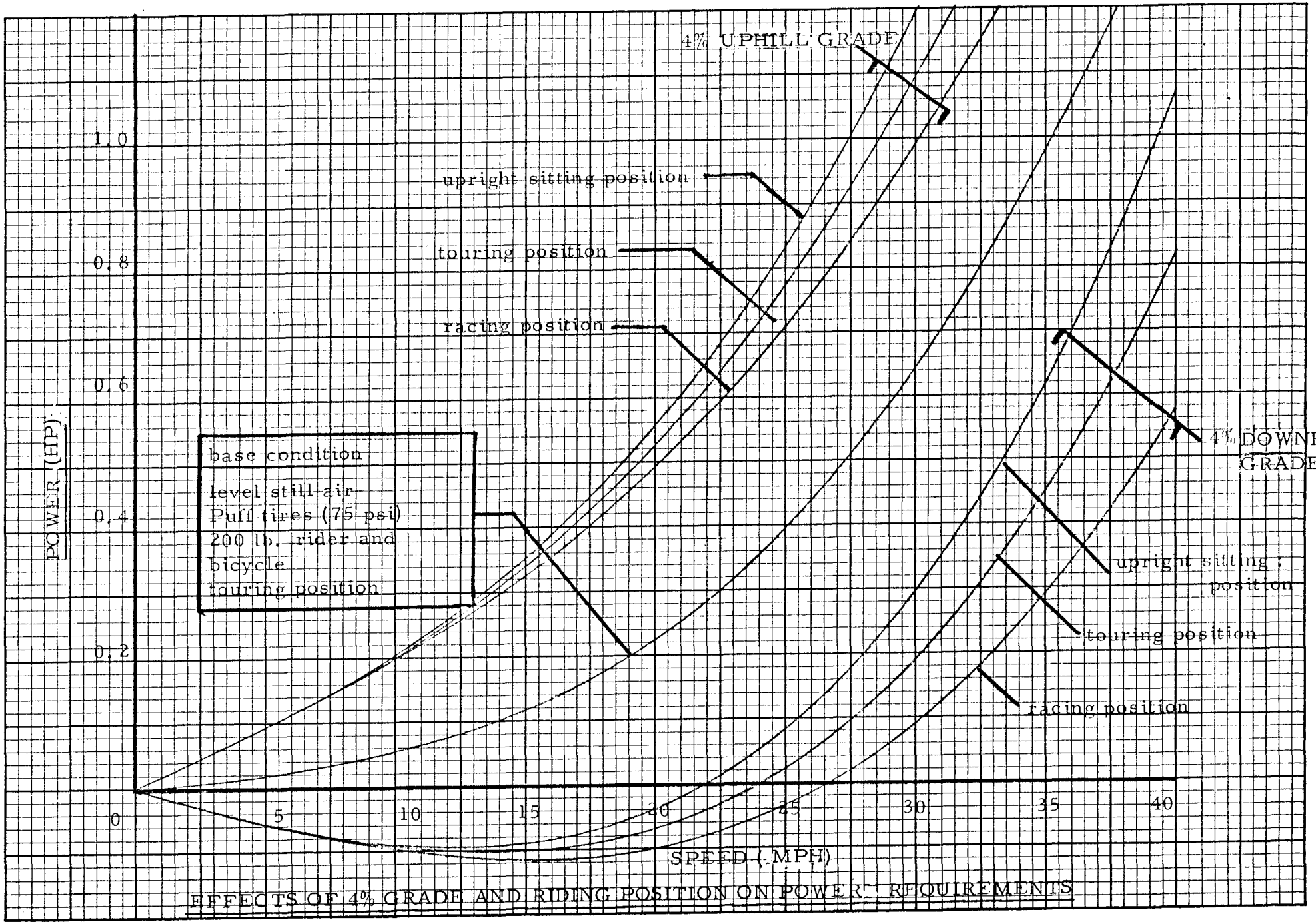
EFFECTS OF TIRES, WEIGHT AND RIDING POSITION ON POWER REQUIREMENTS FOR 5% UPHILL GRADE AND STILL AIR.



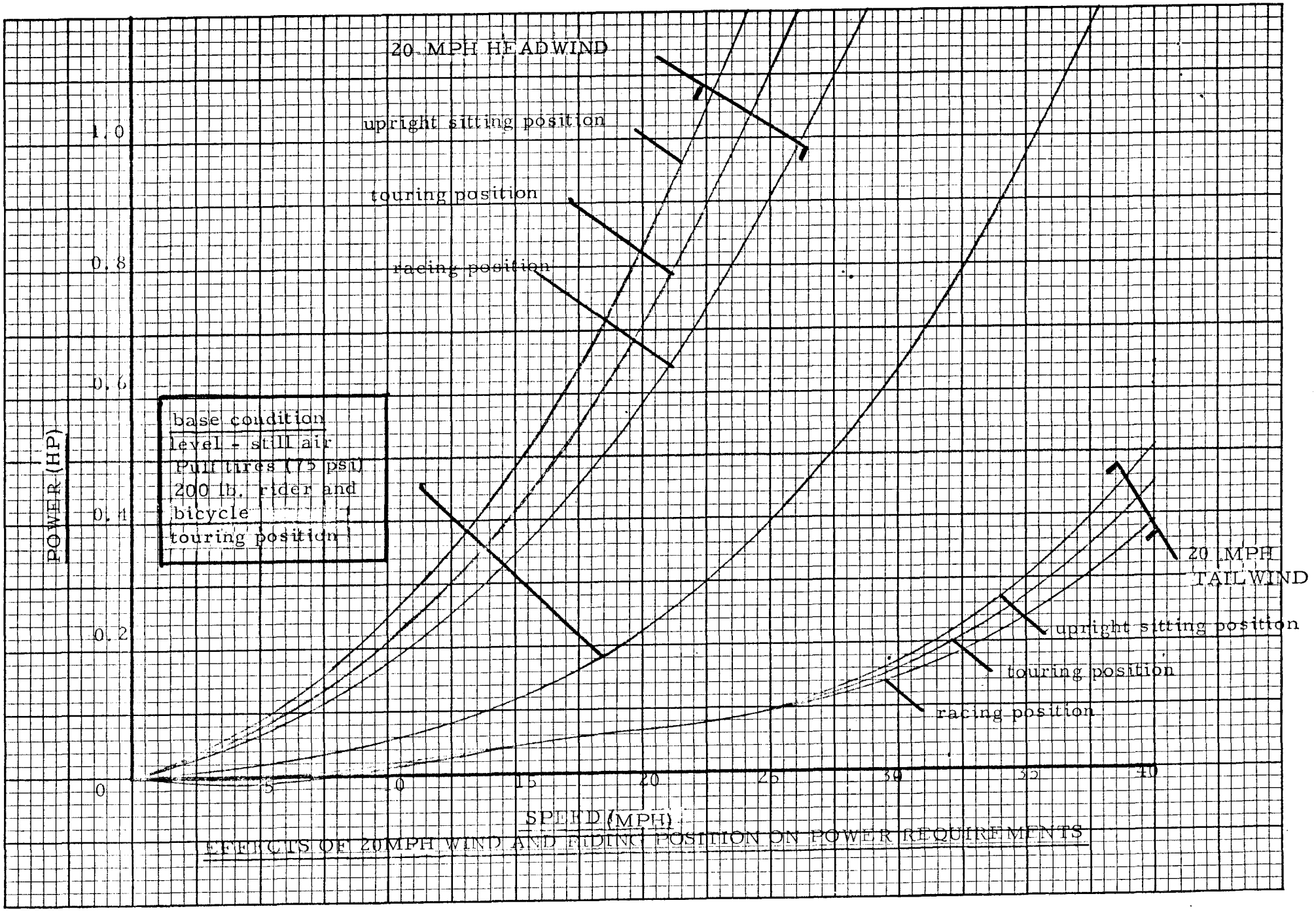
EFFECTS OF TIRES, WEIGHT AND RIDING POSITION ON POWER REQUIREMENTS FOR LEVEL ROAD AND 10 MPH HEADWIND



EFFECTS OF 10 MPH WIND AND RIDING POSITION ON POWER REQUIREMENTS



EFFECTS OF 4% GRADE AND RIDING POSITION ON POWER REQUIREMENTS



EFFECTS OF 20MPH WIND AND RIDING POSITION ON POWER REQUIREMENTS

PHYSICAL CHARACTERISTICS OF THE 26 INCH SCHWINN P15 PARAMOUNT 22JUN'72

WHEELBASE (IN)	42.00
TOTAL WEIGHT OF BICYCLE (LB)	25.50
LOCATION OF TOTAL BICYCLE C.G. FORWARD OF REAR WHEEL CENTER (IN)	19.20
LOCATION OF TOTAL BICYCLE C.G. ABOVE GROUND (IN)	21.00
ROLL MOMENT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	8.51
PITCH MOMENT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	25.04
YAW MOMENT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	18.07
ROLL-YAW PRODUCT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	-2.57

WEIGHT OF RIDER (LB)	0.0
LOCATION OF RIDER C.G. FORWARD OF REAR WHEEL CENTER (IN)	0.0
HEIGHT OF RIDER C.G. ABOVE GROUND (IN)	0.0
HEIGHT OF SADDLE ABOVE GROUND (IN)	0.0
ROLL MOMENT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0
PITCH MOMENT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0
YAW MOMENT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0
ROLL-YAW PRODUCT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0

WEIGHT OF FRONT FORK ASSEMBLY (FORK,WHEEL,AND HANDLE BARS),(LB)	7.30
PERPENDICULAR DISTANCE FROM C.G. OF FRONT FORK ASSEMBLY TO STEER AXIS (IN)	1.90
DISTANCE PARALLEL TO STEER AXIS FROM C.G. OF FRONT FORK ASSEMBLY TO FRONT WHEEL CENTER (IN)	11.00
ROLL MOMENT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT AN AXIS PERPENDICULAR TO THE STEER AXIS THROUGH C.G. OF ASSEMBLY (LB-IN-SEC SQ)	2.59
PITCH MOMENT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT AN AXIS THROUGH THE C.G. OF THE ASSEMBLY (LB-IN-SEC SQ)	2.75
YAW MOMENT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT THE STEER AXIS (LB-IN-SEC SQ)	0.71
ROLL-YAW PRODUCT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT AN AXIS THROUGH THE C.G. OF THE ASSEMBLY (LB-IN-SEC SQ)	-0.17

CASTER ANGLE OF THE STEER AXIS (DEG)	17.40
FORK OFFSET (IN)	2.10
UNDEFLECTED WHEEL ROLLING RADIUS (IN)	13.50
TIRE SECTION WIDTH (IN)	1.00
RADIAL STIFFNESS OF TIRE (LB/IN)	1000.00
SPIN MOMENT OF INERTIA OF THE FRONT WHEEL (LB-IN-SEC SQ)	0.73
SPIN MOMENT OF INERTIA OF THE REAR WHEEL (LB-IN-SEC SQ)	0.73
FIRST AND SECOND ORDER COEFFICIENTS RELATING TIRE SIDE FORCE AND SLIP ANGLE	0.0 0.0
FIRST AND SECOND ORDER COEFFICIENTS RELATING TIRE SIDE FORCE AND INCLINATION ANGLE	0.0 0.0
COEFFICIENT OF ROLLING RESISTANCE (LB/LB)	0.0
AERODYNAMIC DRAG COEFFICIENT (LB/MPH-SQ)	0.0

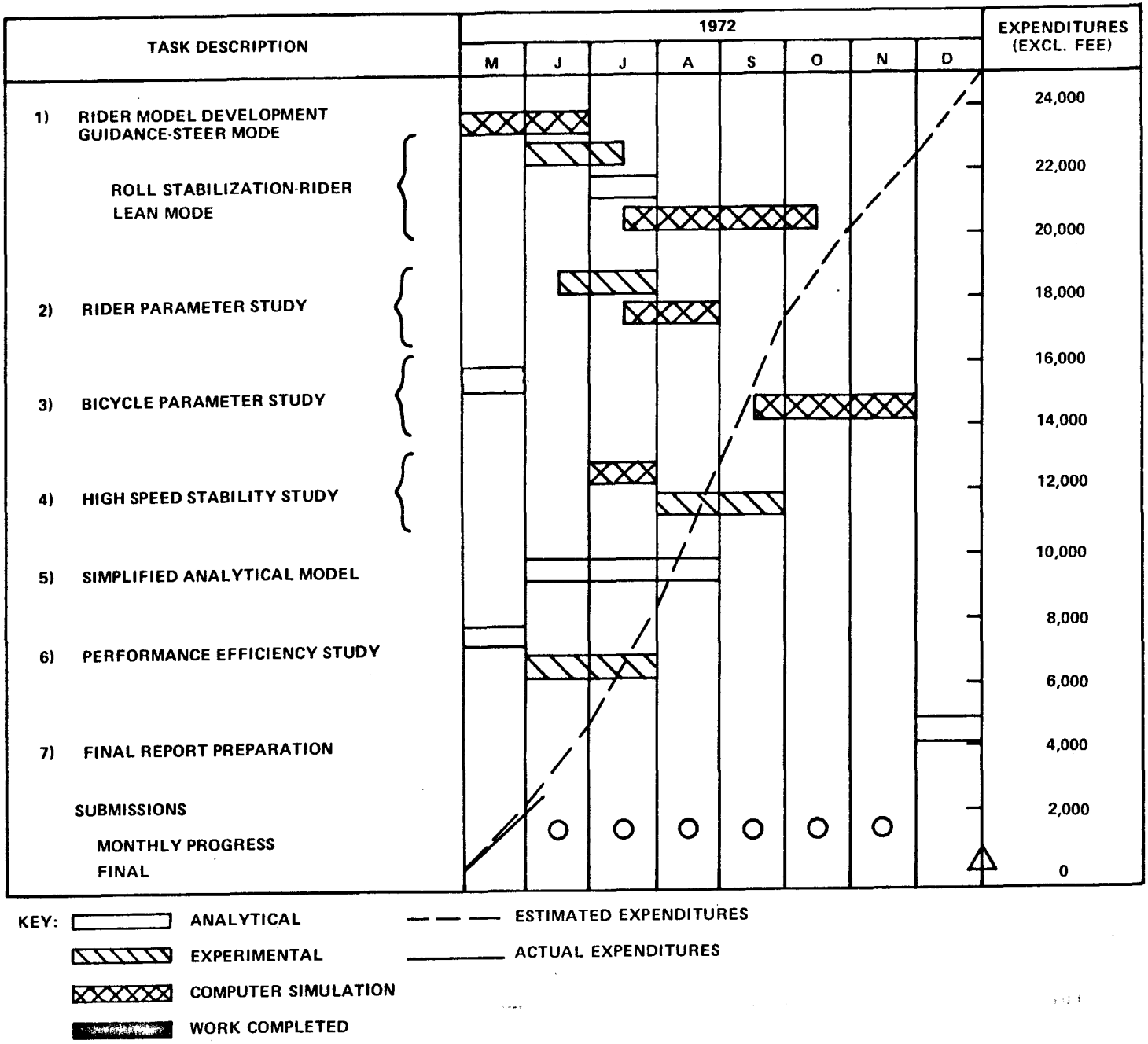
PHYSICAL CHARACTERISTICS OF THE SCHWINN J38-6 STING-RAY . 22JUN'72

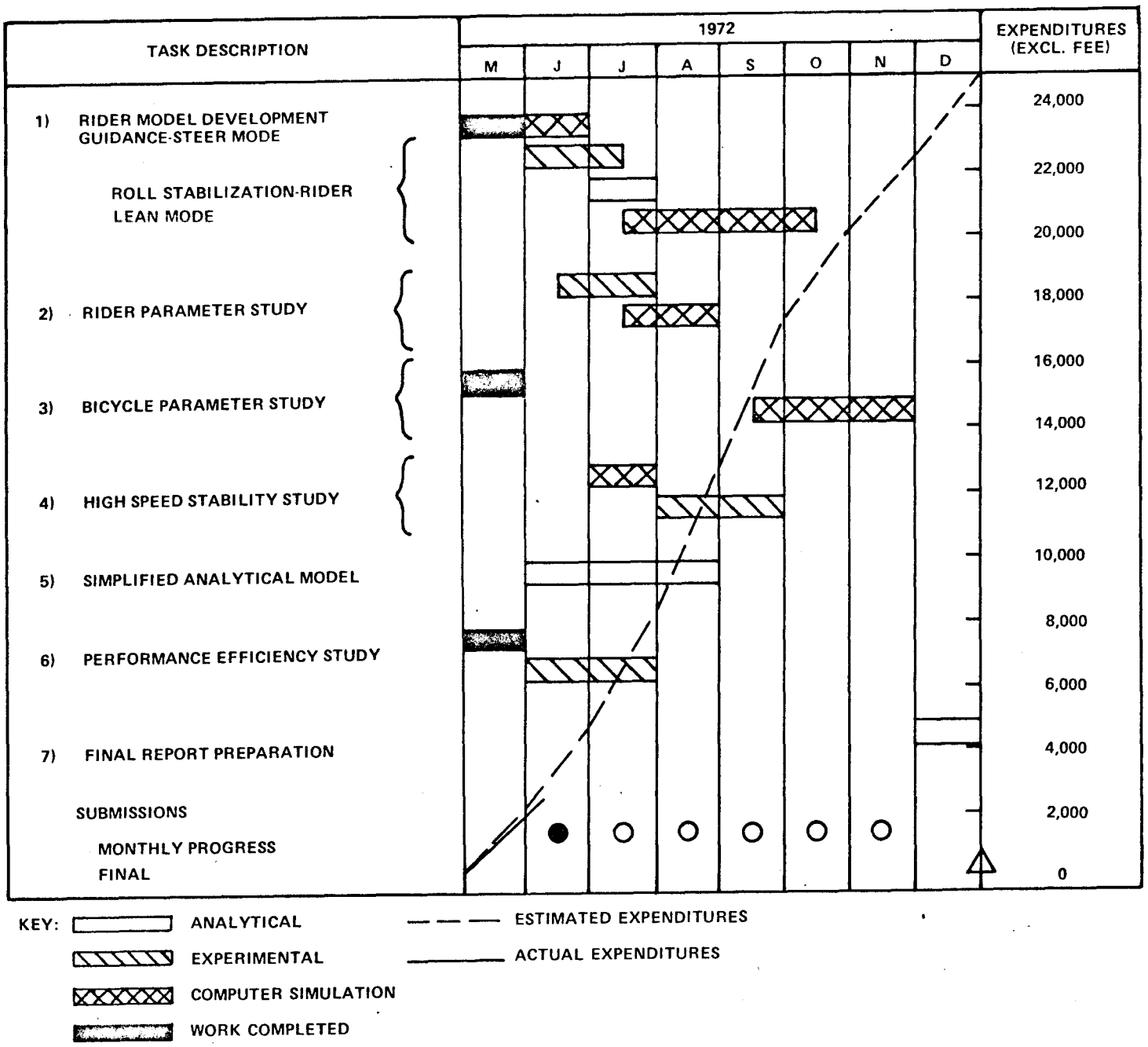
WHEELBASE (IN)	35.00
TOTAL WEIGHT OF BICYCLE (LB)	36.70
LOCATION OF TOTAL BICYCLE C.G. FORWARD OF REAR WHEEL CENTER (IN)	15.10
LOCATION OF TOTAL BICYCLE C.G. ABOVE GROUND (IN)	15.50
ROLL MOMENT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	8.54
PITCH MOMENT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	24.16
YAW MOMENT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	17.22
ROLL-YAW PRODUCT OF INERTIA OF THE TOTAL BICYCLE ABOUT AXIS THROUGH TOTAL C.G. (LB-IN-SEC SQ)	-1.96

WEIGHT OF RIDER (LB)	0.0
LOCATION OF RIDER C.G. FORWARD OF REAR WHEEL CENTER (IN)	0.0
HEIGHT OF RIDER C.G. ABOVE GROUND (IN)	0.0
HEIGHT OF SADDLE ABOVE GROUND (IN)	0.0
ROLL MOMENT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0
PITCH MOMENT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0
YAW MOMENT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0
ROLL-YAW PRODUCT OF INERTIA OF RIDER ABOUT AN AXIS THROUGH HIS C.G. (LB-IN-SEC SQ)	0.0

WEIGHT OF FRONT FORK ASSEMBLY (FORK,WHEEL,AND HANDLE BARS),(LB)	10.20
PERPENDICULAR DISTANCE FROM C.G. OF FRONT FORK ASSEMBLY TO STEER AXIS (IN)	1.50
DISTANCE PARALLEL TO STEER AXIS FROM C.G. OF FRONT FORK ASSEMBLY TO FRONT WHEEL CENTER (IN)	10.30
ROLL MOMENT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT AN AXIS PERPENDICULAR TO THE STEER AXIS THROUGH C.G. OF ASSEMBLY (LB-IN-SEC SQ)	3.87
PITCH MOMENT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT AN AXIS THROUGH THE C.G. OF THE ASSEMBLY (LB-IN-SEC SQ)	4.05
YAW MOMENT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT THE STEER AXIS (LB-IN-SEC SQ)	1.29
ROLL-YAW PRODUCT OF INERTIA OF FRONT FORK ASSEMBLY ABOUT AN AXIS THROUGH THE C.G. OF THE ASSEMBLY (LB-IN-SEC SQ)	0.41

CASTER ANGLE OF THE STEER AXIS (DEG)	21.00
FORK OFFSET (IN)	1.60
UNDEFLECTED WHEEL ROLLING RADIUS (IN)	10.00
TIRE SECTION WIDTH (IN)	1.75
RADIAL STIFFNESS OF TIRE (LB/IN)	500.00
SPIN MOMENT OF INERTIA OF THE FRONT WHEEL (LB-IN-SEC SQ)	0.69
SPIN MOMENT OF INERTIA OF THE REAR WHEEL (LB-IN-SEC SQ)	0.69
FIRST AND SECOND ORDER COEFFICIENTS RELATING TIRE SIDE FORCE AND SLIP ANGLE	0.0 0.0
FIRST AND SECOND ORDER COEFFICIENTS RELATING TIRE SIDE FORCE AND INCLINATION ANGLE	0.0 0.0
COEFFICIENT OF ROLLING RESISTANCE (LB/LB)	0.0
AERODYNAMIC DRAG COEFFICIENT (LB/MPH-SQ)	0.0


TASK DESCRIPTION
1972
M
J
J
A
S
O
N
D
EXPENDITURES (EXCL. FEE)
1) RIDER MODEL DEVELOPMENT GUIDANCE-STEER MODE
ROLL STABILIZATION-RIDER LEAN MODE
2) RIDER PARAMETER STUDY
3) BICYCLE PARAMETER STUDY
4) HIGH SPEED STABILITY STUDY
5) SIMPLIFIED ANALYTICAL MODEL
6) PERFORMANCE EFFICIENCY STUDY
7) FINAL REPORT PREPARATION
SUBMISSIONS
MONTHLY PROGRESS
FINAL
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
KEY:
ANALYTICAL
EXPERIMENTAL
COMPUTER SIMULATION
WORK COMPLETED
ESTIMATED EXPENDITURES
ACTUAL EXPENDITURES


TASK DESCRIPTION
1972
M
J
J
A
S
O
N
D
EXPENDITURES (EXCL. FEE)
1) RIDER MODEL DEVELOPMENT GUIDANCE-STEER MODE
ROLL STABILIZATION-RIDER LEAN MODE
2) RIDER PARAMETER STUDY
3) BICYCLE PARAMETER STUDY
4) HIGH SPEED STABILITY STUDY
5) SIMPLIFIED ANALYTICAL MODEL
6) PERFORMANCE EFFICIENCY STUDY
7) FINAL REPORT PREPARATION
SUBMISSIONS
MONTHLY PROGRESS
FINAL
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
KEY:
ANALYTICAL
EXPERIMENTAL
COMPUTER SIMULATION
WORK COMPLETED
ESTIMATED EXPENDITURES
ACTUAL EXPENDITURES